

***Eptatretus longipinnis*, n. sp., A New Hagfish (Family Eptatretidae) from South Australia, with a Key to the 5-7 Gilled Eptatretidae.**

R. STRAHAN

Australian Museum, College St., Sydney, N.S.W. 2000

ABSTRACT

A new species of hagfish, *Eptatretus longipinnis* (Family Eptatretidae) based on a specimen from coastal waters near Robe, South Australia, is described. The species differs from other members of the genus in having a well developed ventral fin-fold extending into the branchial region. The genus *Paramyxine* is regarded as a junior synonym of *Eptatretus*. A key is given to the species of *Eptatretus* having 5-7 pairs of gills.

INTRODUCTION

Until 1971 no hagfishes had been recorded from Australian waters. Since then a number of specimens of *Eptatretus cirrhatius* have been taken from the Pacific Ocean off the coast of New South Wales in deep trawls (300-700m). Also in 1971, a quite different hagfish was taken from the south-eastern Indian Ocean near Robe, South Australia from a depth of approximately 40m. The hagfish had burrowed into the flesh of the abdomen of a spiny lobster and was still embedded when the lobster was brought to the surface. The specimen, preserved in alcohol, was forwarded to the author by Dr. C. J. M. Glover of the South Australian Museum.

DESCRIPTION OF *EPTATREUS LONGIPINNIS*, N. SP.

*Holotype*: A specimen 422mm long from south-eastern Indian Ocean off Robe, South Australia (149°43'E, 37°10'S) at depth of approximately 40m. In the South Australian Museum, Adelaide, South Australia (registration number F4042).

Major dimensions	mm	% length
Rostrum to first branchial aperture	120	29
Rostrum to last branchial aperture	139	33
Rostrum to origin ventral fin-fold	112	26
Rostrum to posterior border cloaca	387	92
Maximum depth of body	18	4

R. STRAHAN

Mucous glands	range	mean
Prebranchial series	27-29	28
Branchial series	5-6	6
Abdominal series	64	64
Caudal series	8-9	9
Total	104-108	106

Lingual teeth: inner 2+5; outer 3+5.

The body is elongate and subcylindrical, slightly deeper than broad, tapering towards either extremity from the middle. The skin is dusky-brown dorsally, clearer brown ventrally. A very slight paling of the skin marks the position of the eyes on the dorsolateral surface of the head, about 18mm behind the rostrum. The distal thirds of the nasal and anterior oral barbels are yellow, as are the margins of the caudal fin and ventral fin-fold. There is no change of pigmentation to mark the borders of the external branchial apertures.

The nasal rostrum is bluntly curved, overlying the nostril which is approximately three times wider than high. The nasal barbels are 7mm long, slender, and taper evenly to a point. (The left ventral nasal barbel is bifid at the tip, possibly the result of injury and regeneration). The anterior oral barbels are 8mm long and similar in shape to the nasal barbels. The posterior oral barbels, which partially overlie the mouth in the anterior midline, are approximately 4mm long and 2.5mm wide.

Six pairs of gills communicate with the exterior by short, nearly vertical, efferent branchial ducts which are approximately equal in length except for the most anterior, which is approximately twice the length of the others due to dorsad displacement of the first gill. The branchial apertures are ventral, arranged on each side of the body in a longitudinal series curving towards the midline as it passes posteriorly. The aperture of the pharyngocutaneous duct, shared with the efferent duct of the sixth gill on the left side, is irregular in outline, somewhat longer than wide.

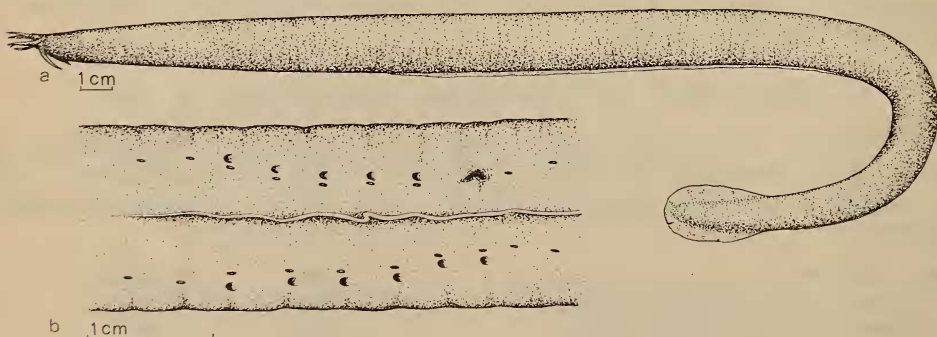


Fig. 1. *Eptatretus longipinnis*, n. sp., holotype. (a) lateral view; (b) ventral view of branchial region showing external branchial apertures, mucous glands and ventral fin-fold.

The cloacal aperture is a longitudinal slit surrounded by lateral lips. The caudal fin, which originates dorsally and ventrally at the level of the posterior end of the cloacal aperture, is bluntly rounded and has a height equal to the maximum height of the body.

A prominent mid-ventral fin-fold originates anterior to the branchial region and extends between the branchial apertures to the anterior border of the cloacal aperture. It reaches a maximum depth of 4 mm in the branchial region.

The prebranchial series of mucous glands begins about 30 mm behind the rostrum on the ventral surface and extends to just in front of the first branchial aperture. The branchial mucous glands are immediately mesial to each branchial aperture except that of the sixth gill on the left side which lacks an associated gland. The abdominal series extends from the posterior end of the branchial region to about 10mm in front of the border of the cloacal aperture. The caudal series extends from the level of the middle of the cloacal aperture to about half the length of the tail.

The lingual tooth plates bear eight teeth in the outer row and seven in the inner. The bases of the anteriormost three teeth of the outer row are fused together, as are those of the anteriormost two of the inner row.

## TAXONOMY OF POLYBRANCHIATE MYXINOIDS

### The status of *Bdellostoma* and *Paramyxine*

The most recent comprehensive review of the Order Myxinoidea (Holly, 1933) recognises two genera of polybranchiate myxinoids: *Bdellostoma* and *Paramyxine*. There is long-standing disagreement on the proper name of the former genus, European workers tending to favour *Bdellostoma* Muller, 1835, while others favour *Eptatretus* Cloquet 1819. Supporters of *Bdellostoma* (e.g. Rauther, 1924; Holly, 1933) argue that *Bdellostoma* has had greater usage but, while this maybe true, it cannot be maintained that *Eptatretus* (or *Heptatretus*) is a forgotten name, resurrected on formal grounds of priority, for it has been in continued use since its introduction. Apstein (1915) included *Bdellostoma* in a list of recommended *nomina conservanda* but the International Commission on Zoological Nomenclature has ruled (Opinion No. 74) that it has no power to adopt this list *en bloc*. In the absence of a ruling to the contrary by the International Commission, the genus is properly called *Eptatretus*.

The retention of *Eptatretus* as a subgenus to include the 5-8 gilled polybranchiate myxinoids has little value and has been criticised by Bigelow and Schroeder (1948), Adam and Strahan (1963), and Hubbs (1963). However, full consideration of this must await a revision of the entire genus, including those species at present included in the subgenus *Polistotrema*.

The diagnosis of the genus *Paramyxine* Dean, 1904 is based on the branchial anatomy of the type of *P. atami* Dean: "Hyperotretes with branchial apertures ventrad of sacs. Ectal branchial ducts of distinctly unequal length, the most anterior several times the length of the most posterior. The duct of the most anterior gill opening at the surface opposite the fourth (or fifth) gill sac. Openings of the branchial ducts drawn close together and compressed transversely, that of the ductus oesophagoicus, however, longitudinally, the latter aperture of large size, its length equalling the sum of the interspaces of several gills. Transverse constrictor muscles of the branchial region developed as a distinct element in the region of the branchial sacs". (Dean 1904, p. 22).

Studies subsequent to Dean's erection of the genus have called these criteria into question. (1) Although the branchial apertures of the species assigned to *Paramyxine* tend to be closer to the mid-ventral line than in those traditionally assigned to *Eptatretus*, the distinction is difficult to assess, and, in the case of *E. longipinnis*, not valid. (2) Differences in length of the anterior and posterior efferent branchial ducts does not separate *Paramyxine* from *Eptatretus*: in *E. burgeri* the anteriormost efferent branchial duct is 2-3 times longer than the most posterior (Strahan, 1962). In *E. cirrhatus* it is approximately twice the length, three randomly chosen specimens having the respective ratios 23:12, 24:11, 2:1. In *E. longipinnis* the anteriormost efferent branchial duct is twice the length of the others but this is due to a dorsad displacement of the first gill rather than a caudad displacement of its efferent branchial aperture. (3) The first branchial aperture of *P. atami* Dean commonly opens at the level of the fourth or fifth gill but may open at the level of the third gill, as in *E. cirrhatus*. (4) The shape of the branchial apertures of *P. atami* Dean is extremely variable (Matsubara, 1937; Strahan and Honma, 1961): in *P. springeri* Bigelow and Schroeder, the apertures are almost circular and in *P. yangi* Teng they are semicircular. (5) The common aperture of the pharyngocutaneous duct and the last gill of the left side is not normally elongated longitudinally in *P. atami* Dean but is subject to considerable variation (Strahan and Honma, 1961): it is almost circular in *P. springeri* Bigelow and Schroeder and *P. yangi* Teng: its size does not bear the relationship to the intervals between the branchial apertures suggested by Dean. (6) The transverse branchial constrictor muscles of *E. burgeri* and *E. cirrhatus* are as well developed as those of *P. atami* Dean.

On the above considerations, I am of the opinion that *Paramyxine* must be regarded as a junior synonym of *Eptatretus*.

#### Taxonomic characters

Regan (1912) diagnosed the polybranchiate myxinoids in terms of the number of gills, the position of the anteriormost branchial aperture, and a rigidly defined dental formula. Holly (1933) followed Regan's general plan but indicated a range of variation in the dental formula and followed Dean in taking note of the position of the posterior end of the lingual musculature with respect to the gill series.



None of those characters is constant. Large samples of a population of myxinoids usually include individuals with more or less than the model number of gills or gill apertures, and the range of variation in the dental formula is so great that there is considerable overlap between species. Moreover, these characters are not readily accessible: the number of gills may be inferred from the number of branchial apertures but these do not always correspond. In most preserved specimens the lingual teeth are retracted within the buccal cavity and a deep incision must be made to reveal them. The smaller teeth lie under a fold of buccal epithelium and are easily overlooked. Clearly it would be advantageous if species of myxinoids could be diagnosed by their external characters.

Studies of variation in the external characters of *E. atami* and *E. burgeri* (Strahan and Honma, 1961; Strahan, 1962) have demonstrated that the position of the first and last branchial apertures, cloaca, and ventral fin-fold; the depth of the body; and the number and distribution of mucous glands provide a constellation of individually variable characters which, taken together, are usually sufficient to define an eptatretid species.

#### COMPARISON OF *EPTATRETUS LONGIPINNIS* WITH OTHER 5-7 GILLED EPTATRETIDS

The six-gilled hagfish, *E. longipinnis* does not fit the description of any of the six-gilled species of *Eptatretus* (= *Bdellostoma*) listed by Holly (1933). However, in view of known variation in the characters considered by Holly, it is reasonable to establish that *E. longipinnis* is not a variant of a species with one more or one less pair of gills. These are: *E. yangi* (Teng) 1958; *E. springeri* (Bigelow and Schroeder) (1952); *E. atami* (Dean) 1904; *E. profundus* Barnard 1923; *E. burgeri* (Gunther) 1870; *E. hexatrema* (Muller) 1835; and *E. cirrhatus* (Bloch and Schneider) 1801.

Not all of these species have been described in sufficient detail to compare them character by character. Where possible, therefore, specimens have been re-examined and described in a standard manner. This has not been possible with *E. yangi* or *E. springeri* but the relatively recent descriptions of these species contain all the information necessary for the present purpose.

#### *Eptatretus yangi*

A description of the type and seven paratypes has been given by Teng (1958). The following is a summary.

Length: 198-250 mm.

Major dimensions as percentage of length	range	mean $\pm$ S.D.
Rostrum to first branchial aperture	29 — 33	32 $\pm$ 1.3
Rostrum to last branchial aperture	31 — 35	33 $\pm$ 1.0
First to last branchial aperture	1 — 2	1.7 $\pm$ 1.2
Rostrum to origin ventral fin-fold	39 — 55	47 $\pm$ 4.5
Rostrum to posterior border cloaca	86 — 88	86 $\pm$ 1.8
Maximum depth of body	5 — 8	6 $\pm$ 0.7

R. STRAHAN

Number of mucous glands	range	mean $\pm$ S.D.
Prebranchial series	17 — 20	18 $\pm$ 1.0
Branchial series		nil
Abdominal series	35 — 40	37 $\pm$ 1.5
Caudal series	7 — 10	9 $\pm$ 1.1
Total	60 — 69	64 $\pm$ 2.8

Lingual teeth: inner 2+6-8; outer 3+6-7.

Five pairs of branchial apertures in two irregular rows on the ventral surface. Violet-brown to violet-grey, paler ventrally; white border to ventral fin and to branchial apertures. South-western coast of Taiwan.

*Eptatretus profundus*

Only the holotype (SAM 13035) in the South African Museum is known. The following data are based on a re-examination of this specimen.

Length: 620 mm.

Major dimensions	mm	% length
Rostrum to first branchial aperture	125	20
Rostrum to last branchial aperture	160	26
Rostrum to origin ventral fin-fold	290	45
Rostrum to posterior border cloaca	505	81
Maximum depth of body	55	9

Number of mucous glands	range	mean
Prebranchial series	13	13
Branchial series	4	4
Abdominal series	50-51	51
Caudal series	15	15
Total	82-83	83

Lingual teeth: inner 2+8; outer 2+8.

Five pairs of ventrolateral branchial apertures arranged in regular rows. Branchial mucous glands dorsal to branchial apertures. Dark brown dorsally and ventrally. Atlantic Ocean, off Cape Pt., South Africa, 720 m depth.

*Eptatretus springeri*

The summary below is based on the detailed description of the holotype and two paratypes (Bigelow and Schroeder, 1952).

Length: 338-590 mm.

Major dimensions as percentage of length	range	mean $\pm$ S.D.
Rostrum to first branchial aperture	23 — 24	23 $\pm$ 0.4
Rostrum to last branchial aperture	26 — 28	27 $\pm$ 1.0
First to last branchial aperture	2 — 6	4 $\pm$ 1.4
Rostrum to origin ventral fin-fold	37 — 50	42 $\pm$ 5.5
Rostrum to posterior border cloaca	82 — 87	85 $\pm$ 1.7
Maximum depth of body	8 — 9	8 $\pm$ 0.5

A NEW HAGFISH FROM SOUTH AUSTRALIA

Number of mucous glands	range	mean $\pm$ S.D.
Prebranchial series	15 — 19	17 $\pm$ 1.7
Branchial series	3 — 6	4 $\pm$ 1.4
Abdominal series	44 — 57	52 $\pm$ 5.5
Caudal series	11 — 14	12 $\pm$ 1.0
Total	77 — 92	86 $\pm$ 5.6

Lingual teeth: inner 2+9-10; outer 3+10-11.

Six pairs of branchial apertures in two regular rows on the ventral surface. Greyish-brown dorsally and ventrally; branchial apertures fringed with white. Gulf of Mexico, 400-500 m; Atlantic Ocean off Florida, 800-900 m; Caribbean, 500 m.

*Eptatretus atami*

Variation in the dimensions of 146 specimens has been described by Strahan and Honma (1961) who diagnosed an eastern and a western form of the species.

The following is a summary.

*Eptatretus atami (western form)*

Length: 130-583 mm.

Major dimensions as percentage of length	range	mean $\pm$ S.D.
Rostrum to first branchial aperture	21 — 36	28 $\pm$ 1.6
Rostrum to last branchial aperture	24 — 39	32 $\pm$ 1.5
First to last branchial aperture		4 $\pm$ 0.3
Rostrum to origin ventral fin-fold	39 — 54	47 $\pm$ 2.7
Rostrum to posterior border cloaca	81 — 92	88 $\pm$ 1.1
Maximum depth of body	5 — 8	6 $\pm$ 0.5

Number of mucous glands

Prebranchial series	16 — 22	19 $\pm$ 1.2
Branchial series		nil
Abdominal series	81 — 92	88 $\pm$ 1.1
Caudal series	9 — 14	11 $\pm$ 1.0
Total	68 — 79	75 $\pm$ 2.6

Lingual teeth: inner 3+6-8; outer 3+5-9.

Six (sometimes 5) pairs of branchial apertures arranged in irregular (rarely regular) rows on the ventral surface. Purplish-brown dorsally, grey ventrally. Sea of Japan, coastal waters of north-western Honshu, Japan, 60-160 m depth.

*Eptatretus atami (eastern form)*

Length: 318-444 mm.

Major dimensions as percentage of length	range	mean $\pm$ S.D.
Rostrum to first branchial aperture	25 — 28	27 $\pm$ 1.0
Rostrum to last branchial aperture	28 — 32	30 $\pm$ 1.3
First to last branchial aperture	2 — 4	3 $\pm$ 0.2
Rostrum to origin ventral fin-fold	29 — 34	31 $\pm$ 1.2
Rostrum to posterior border cloaca	86 — 87	87 $\pm$ 0.3
Maximum depth of body	8 — 10	9 $\pm$ 0.5

R. STRAHAN

Number of mucous glands	range	mean $\pm$ S.D.
Prebranchial series	15 — 18	17 $\pm$ 1.1
Branchial series		nil
Abdominal series	44 — 47	46 $\pm$ 1.1
Caudal series	8 — 9	9 $\pm$ 1.1
Total	68 — 72	71 $\pm$ 2.1

Lingual teeth: inner 3+8-9, outer 3+8-9.

Six pairs of branchial apertures arranged in regular or irregular rows on the ventral surface. Purplish-brown dorsally, grey ventrally. Pacific Ocean, coastal waters of north-eastern Honshu, Japan, 50-490 m depth.

*Eptatretus burgeri*

The summary description below is based upon six specimens in the collection of the Imperial University of Tokyo and six in the collection of the Enoshima Aquarium, Japan.

Length: 235-435 mm.

Major dimensions as percentage of length	range	mean $\pm$ S.D.
Rostrum to first branchial aperture	26 — 30	29 $\pm$ 1.3
Rostrum to last branchial aperture	32 — 35	34 $\pm$ 1.0
First to last branchial aperture	4 — 6	5 $\pm$ 0.6
Rostrum to origin ventral fin	46 — 54	50 $\pm$ 2.0
Rostrum to posterior border cloaca	84 — 90	87 $\pm$ 1.5
Maximum depth of body	7 — 8	7.5 $\pm$ 0.3

Number of mucous glands	range	mean $\pm$ S.D.
Prebranchial series	19 — 22	21 $\pm$ 0.9
Branchial series	5	5
Abdominal series	45 — 50	48 $\pm$ 1.3
Caudal series	11 — 14	12 $\pm$ 0.8
Total	81 — 89	85 $\pm$ 2.1

Lingual teeth: inner 2+6-7; outer 3+6-7.

Six (rarely 5 or 7) pairs of branchial apertures in regular ventrolateral rows. Light brown to purplish-brown dorsally, paler ventrally; thin unpigmented mid-dorsal stripe; conspicuous pale patch of skin (translucent in life) over eye; tips of barbels pale. Southern Japan, southern Korea, 5-10 m depth.

*Eptatretus hexatrema*

The summary description below is based on six specimens in the British Museum and eight in the South African Museum.

Length: 112-720 mm.

Major dimensions as percentage of length	range	mean $\pm$ S.D.
Rostrum to first branchial aperture	27 — 32	30 $\pm$ 1.7
Rostrum to last branchial aperture	32 — 39	36 $\pm$ 1.9
First to last branchial aperture	5 — 6	6 $\pm$ 0.4
Rostrum to origin ventral fin	47 — 54	51 $\pm$ 2.6
Rostrum to posterior border of cloaca	85 — 88	86 $\pm$ 1.1
Maximum depth of body	6 — 7	6.5 $\pm$ 0.3



## A NEW HAGFISH FROM SOUTH AUSTRALIA

Number of mucous glands		
Prebranchial series	24 — 27	26 ± 1.0
Branchial series	5	5
Abdominal series	50 — 60	54 ± 3.4
Caudal series	11 — 14	13 ± 1.1
Total	91 — 105	98 ± 4.9

Lingual teeth: inner 2+8-10; outer 3+8-10.

Six (rarely 5) pairs of branchial apertures opening ventrolaterally in regular rows. Light brown to blackish-brown dorsally, paler ventrally. South Atlantic Ocean off Cape of Good Hope, 10-45 m depth.



Fig. 2. Ventral view of heads of 5-7 gilled species of *Eptatretus*. (a) *E. longipinnis*, n. sp., 422 mm long, holotype; (b) *E. cirrhatus*, 660 mm long; (c) *E. burgeri*, 400 mm long; (d) *E. atami*, 350 mm long. (e) *E. springeri*, 590 mm long (after Bigelow & Schroeder); (f) *E. profundus*, 620 mm long; (g) *E. hexatrema*, 285 mm long; (h) *E. yangi*, 212 mm long (after Teng). Note that figures differ in scale: line below each figure is equivalent to 10 mm in length.

### *Eptatretus cirrhatus*

The following summary description is based upon three specimens in the British Museum and ten from the National Museum, Wellington, New Zealand.

Dimensions as percentage of total length	range	mean ± S.D.
Rostrum to first branchial aperture	21 — 26	23 ± 1.8
Rostrum to last branchial aperture	28 — 33	31 ± 1.3
First to last branchial aperture	6 — 9	7 ± 1.1
Rostrum to origin ventral fin	47 — 55	52 ± 3.5
Rostrum to posterior border cloaca	80 — 86	84 ± 1.4
Maximum depth body	7 — 9	8.5 ± 0.3

R. STRAHAN

Number of mucous glands	range	mean $\pm$ S.D.
Prebranchial series	15 — 18	16 $\pm$ 1.0
Branchial series	6 — 7	6.5 $\pm$ 0.2
Abdominal series	49 — 54	51 $\pm$ 1.7
Caudal series	12 — 14	13 $\pm$ 1.0
Total	83 — 92	87 $\pm$ 2.7

Lingual teeth: inner 3+6-9; outer 3+6-9.

Seven (rarely 6) pairs of branchial apertures opening ventrally. Blackish-brown to brown dorsally, paler ventrally; prominent clear area over eye; white borders to branchial apertures. South Pacific Ocean off both islands of New Zealand, 8-10 m depth; off south-eastern coast of Australia, 300-700 m depth.

DISCUSSION

It is not difficult to separate *E. longipinnis* from the other species described above. In four characters—the anterior position of the ventral fin, the posterior position of the cloaca, the large number of abdominal mucous glands, and the small number of lingual teeth—values for *E. longipinnis* fall outside the combined range of the other species. In two characters, position of the ventral fin and position of the cloaca, values for *E. longipinnis* fall outside three standard deviations from the mean values for any of the other species. Indeed, in respect of the characters under consideration, *E. longipinnis* differs more from each of the other species or varieties than any two of them differ from each other.

KEY TO THE SPECIES OF *EPTATRETUS* HAVING 5-7 PAIRS OF BRANCHIAL APERTURES

- 1a Origin of ventral fin-fold anterior to third gill aperture ..... *longipinnis*
- 1b Origin of ventral fin-fold posterior to third gill aperture ..... 2
- 2a First gill aperture to last gill aperture more than 6% of total length ..... *cirrhatius*
- 2b First gill aperture to last gill aperture less than 6% of total length ..... 3
- 3a Pale mid-dorsal stripe ..... *burgeri*
- 3b No mid-dorsal stripe ..... 4
- 4a Less than 22 prebranchial mucous glands ..... *hexatrema*
- 4b More than 22 prebranchial mucous glands ..... 5
- 5a Rostrum to origin ventral fin less than 40% of total length ..... *atami* (western)
- 5b Rostrum to origin ventral fin more than 40% of total length ..... 6
- 6a Branchial mucous glands absent ..... 7
- 6b Branchial mucous glands present ..... 8
- 7a First gill aperture to last gill aperture more than 3% of total length .... *atami* (eastern)
- 7b First gill aperture to last gill aperture less than 3% of total length ..... *yangi*
- 8a Branchial mucous glands dorsal to gill apertures ..... *profundus*
- 8b Branchial mucous glands ventral to gill apertures ..... *springeri*

ACKNOWLEDGEMENTS

Thanks are due to the South Australian Museum; the South African Museum; the British Museum; the National Museum of New Zealand; the Imperial University, Tokyo, and its Marine Research Station, Misaki. Niigata University; the Enoshima Aquarium, and the N.S.W. State Fisheries, for providing access to their collections.

## A NEW HAGFISH FROM SOUTH AUSTRALIA

### ADDENDUM

While this paper was in press, a second specimen, 443 mm long, from South Australia "off Cape Douglas" (South Australian Museum No. F3611) came to hand. In this specimen the branchial region is slightly longer (1% total length) than in the type, and is slightly asymmetrical, the anteriormost branchial aperture on the right side being anterior (0.2% total length) to that on the left. The origin of the ventral fin-fold is at the level of the latter. Otherwise, this specimen corresponds well with the type.

Major dimensions	mm	% length
Rostrum to first branchial aperture	133-134	30
Rostrum to last branchial aperture	154	35
Rostrum to origin ventral fin-fold	134	30
Rostrum to posterior border cloaca	410	93
Maximum depth of body	21	5
Mucous glands	range	mean
Prebranchial series	27-28	28
Branchial series	5-6	6
Abdominal series	60-63	62
Caudal series	9	9
Total	102-105	104

Lingual teeth: inner 2+5; outer 3+5-6.

### REFERENCES

- ADAM, H. & R. STRAHAN (1963). Systematics and geographical distribution of myxinoids. In 'The Biology of Myxine', (Ed. A. Brodal & R. Fange) Universitetsforlaget, Oslo, 1-8.
- APSTEIN, C. (1915). Nomina conservanda. Sitzber. Ges. naturf. Freunde Berl., No. 5, 119-202.
- BARNARD, K. H. (1923). Diagnoses of marine fishes from South African waters. Ann. S. Afr. Mus. 13, 439-445.
- BIGELOW, H. B. & W. C. SCHROEDER (1948). Cyclostomes. In 'Fishes of the Western North Atlantic No. 1, Pt. 1, Sears Found. Mar. Res., New Haven, 29-58.
- BIGELOW, H. B. & W. C. SCHROEDER (1952). A new species of the cyclostome genus *Paramyxine* from the Gulf of Mexico. Brev. Mus. comp. Zool. Harvard No. 8, 1-10.
- DEAN, B. (1904). Notes on Japanese myxinoids, a new genus *Paramyxine* and a new species *Homea okinoseana*, reference also to their eggs. J. Coll. Sci. Univ. Tokyo 19, 1-23.
- HOLLY, M. (1933). Cyclostomata. In 'Das Tierreich' Lief. 59 (Ed. F. E. Schultze & W. Kukenthal) de Gruyter, Berlin & Leipzig, 1-62.
- HUBBS, C. L. (1963). Cyclostomata. In 'Encyclopaedia Britannica' 6, 941-944.
- MATSUBARA, K. (1937). Studies on the deep-sea fishes of Japan. III. On some remarkable variations found in *Paramyxine atami* Dean, with special reference to its taxonomy. J. imp. Fish. Inst. Tokyo 32, 13-15.
- RAUTHER, M. (1924). Cyclostomi. In 'Bronn's Klassen und Ordnungen des Tier-Reichs' 6, Abt. 1, Buch 1, Lief 39, Akad. Verlag. Leipzig, 250-703.
- REGAN, C. T. (1912). A synopsis of the myxinoids of the genus *Heptatretus* or *Bdellostoma*. Ann. Mag. nat. Hist. (8) 7, 534-536.

R. STRAHAN

- STRAHAN, R. (1962). Variation in *Epiplatys burgeri*, with a further description of the species. *Copeia*, 801-807.
- STRAHAN, R. & Y. HONMA (1961). Variation in *Paramyxine*, with a redescription of *P. springeri* Bigelow and Schroeder. *Bull. Mus. comp. Zool. Harvard* 125, 323-342.
- TENG, F. T. (1958). A new species of cyclostome from Taiwan. *Chin. aquat. Prod.* (Chin. Fish.) No. 66, 3-6. (In Chinese).
-